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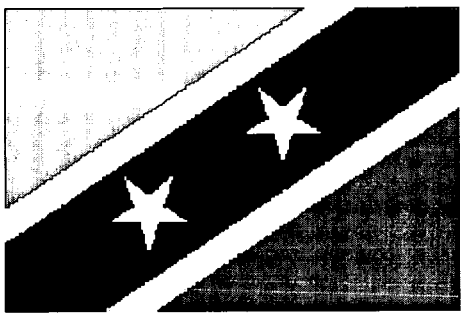
ABSTRACT

This document outlines the existing conditions of school buildings and their vulnerability to natural hazards on the island of St. Kitts, and makes recommendations on how to better protect them from these hazards. Profiles of the schools are detailed and the roles and responsibilities of the various organizations concerning construction, reconstruction, retrofitting, and damage repair are highlighted. Also included is an assessment of the types and prevalence of specific natural hazards that can affect the islands and the vulnerability of each school to these hazards. The existing policies pertaining to school buildings and shelters are addressed along with existing norms, performance standards, and building codes, as well as maintenance, and community involvement. Final comments explore the processes in school infrastructure, including design, construction, retrofitting, and repair, and the existing country plans and strategies in disaster planning. A list of conclusions and recommendations to make school buildings less vulnerable to natural hazards concludes the report. An appendix contains the mandates related to vulnerability reduction in the education sector. (GR)

PLAN TO REDUCE THE VULNARBILITY OF SCHOOL BUILDING TO NATURAL HAZARDS IN ST. KITTS



Government of St. Kitts and Nevis

Organization of American States
United States Agency for International Development
European Community Humanitarian Office

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1.0 INTRODUCTION

1.1 Objective of the Plan

This plan addresses the vulnerability of school buildings and their potential use as shelter to impacts from natural hazards. This plan confronts issues of vulnerability and, in its findings and recommendations sections, identifies measures and modalities and their implementation.

1.2 Use of this Document:

This document is intended for use by officials of the Ministry of Education, the Planning Unit, Public Works, National Emergency Management Agency (NEMA), Organization of American States (OAS) and Caribbean Development Bank (CDB). The document is intended as a baseline in the initial exercise of reducing vulnerability and risk to school buildings and school buildings as shelters.

2.0 THE SCHOOL CONSTRUCTION SECTOR

2.1 Profile of the buildings (building type and design)

Table 1 describes the inventory, with the type and total number of school buildings in St. Kitts by indicating, location, number of storeys, the year built, the funding source and the number of students enrolled.

The type of building varies considerably from a two storey substantially constructed building in the case of the Basseterre Senior High and Basseterre Junior High; to single storied structures with steel frames and infill blockwork with louvered or shuttered windows for protection from the rain. The school buildings have been designed and a funded from a variety of sources and have been built to sundry designs with different specifications. The principal reason for this is that the Ministry of Education has not centrally planned its building requirements but rather deals with, and negotiates with, sources who have historically provided essentially a design and build turnkey project with financing provided.

2.2 Responsible Agency and Collaborators for:

i. Design

As mentioned above structural design has not been a centrally planned component of a new school delivery process in the past. Indeed, the typical historical situation has been one where a design and build turnkey project with funding assistance has been sought. More latterly however, the Planning Unit and the Ministry of Education have collaborated to provide a locally drawn plan and a set of specifications with local contractors providing building services on a tender basis with supervision by Public Works and funding from external sources i.e. EDF, BDD, CIDA and GOV'T.

TABLE 1

List of Government Sponsored School Buildings

	Name of School	Address	Number of Floors	Year Built	Funding Source	Number of Students
Primary Schools						
1	Beach Allen	Taylors Range	1	1990	EDF	200
2	Bronte Welsh	Trinity	1	1991	EDF	100
3	Cayon	Cayon	1	1947	CIDA	200
4	Dr. William Connor	St. Johnston Village	2	1988	EDF	100
5	Dieppe Bay	Dieppe Bay	1	1996	EDF	100
6	Estridge	Estridge	1	1990	OAS	100
7	Irishtown	Irishtown	1	1984	CIDA	100
8	Molineaux	Monineaux	1	1940/80	Gov't	200
9	Newton Ground	Newton Ground	1	1940/90	Gov't	100
10	Newtown	Ponds Pasture	1	1960's	N/A	100
11	Saddlers All Age	Saddlers Village	1	1960	BDD	100
12	Sandy Point	Sandy Point	1	1983	BDD	200
13	St. Peters	St. Peters	1	1990[3]	BDD	100
14	St. Pauls	St. Pauls	1	1980	BDD	100
15	Tabernacle	Tabernacle	1	1970s	BDD	100
16	Verchilds	Verchilds	1	Under construction	Gov't	400
Secondary Schools						
17	Basseterre High	Victoria Road	2	1960s	BDD	801
18	Basseterre Junior	Taylors Range	2	1979	BDD	850
19	Cayon High	Cayon	2	1974	CIDA	803
20	Sandy Point	Sandy Point	2	1972	BDD	801

	High					
21	Verchilds High	Verchilds	1	1960	BDD	410

EDF European Development Fund

BDD British Development Division

CIDA Canadian International Development Agency

Gov't Government of St. Kitts and Nevis

ii. **Construction**

Whether historically or more latterly, this has almost always been by local contractors working with designs produced either abroad or locally.

iii. **Reconstruction after Destruction**

Hurricane Hugo in 1989 and Hurricanes Luis and Marilyn of 1995, both caused substantial impact to school buildings throughout the Federation. In all cases reconstruction, after impact, there being only one school which was entirely destroyed i.e. St. Peter's Primary, was carried out by Public Works and/or private contractors as circumstances dictated and warranted.

iv. **Retrofitting**

This would normally be provided by the Public Works Department who has primary responsibility for maintenance and rehabilitation as well as retrofitting. Depending on the extent of any retrofitting programme, local private contractors could be utilized who certainly have the capacity to carry out a retrofitting programme. It should, however, be noted that any major retrofitting would have to be carried out during the summer vacation period. If large numbers of schools were involved, then clearly the Public Works Department would have a fundamental capacity problem and local contractors would potentially be required to assist.

v. **Repair after Damage**

Repair work after damage, from whatever source, would essentially be handled in the same way as retrofitting. That is Public Works would be the lead agency. However, when larger amounts of works are required, a supplemental effort could and should be sought from the private sector by building contractors.

vi. **Maintenance**

Maintenance is currently carried out by the Public Works Department on request from the Ministry of Education. The Ministry of Education has recently made an application to the central authority in Government for funds to control their own maintenance programme. There is strong sentiment in the Ministry of Education that this is the best route to proceed. The procedure would facilitate the design and implementation of not only routine maintenance but also preventative maintenance. Additional benefits would be enhanced, direct and more cost-effective management control within the Ministry of Education of

the entire maintenance environment for school buildings.

3.0 PREVALENT NATURAL HAZARDS

3.1 General

There are a number of natural hazards that are endemic in the region. St. Kitts is particularly vulnerable to hurricanes, earthquakes, volcanic eruptions and floods. Landslides and fires present a lower level of risk.

St. Kitts is located in the eastern Caribbean at 17° 15' north 62° 40' west with an average annual rainfall of 55 inches per year. Hurricanes as a natural hazard have the highest degree of frequency and historically have produced the largest overall impact in terms of financial and social costs.

3.2 Hurricanes

Severe hurricanes have affected St. Kitts since recorded history. In 1772 a very serious hurricane destroyed almost every house on St. Kitts. Major hurricanes hit St. Kitts in 1899, 1924, and number four of 1928, is considered to be a very severe category hurricane. In 1989 Hurricane Hugo impacted St. Kitts and in 1995 Hurricanes Luis and Marilyn had severe impact on the island during September. Research by the Engineering Department of the University of the West Indies indicates that the frequency of a category five hurricane to impact on St. Kitts is once in every 69 years. However, severe hurricanes where high winds are expected are not the only type of hurricane that can have substantial impact and produce significant damage.

Hurricanes Luis and Marilyn in September 1995 damaged not only the housing stock, but also impacted tourism arrivals, damaged tourist plant, as well as severely impacted the agricultural sector. Soil erosion washed out a large section of the sugar cane railway, the only means of delivering cane to the sugar factory.

3.3 Earthquakes

The Eastern Caribbean is an earthquake prone region, there are minor tremors on a fairly frequently basis in St. Kitts but no major activity has been recorded within the last 20 years. More information on seismic vulnerability in the Caribbean can be obtained from William McCann's article, "On the Earthquake Hazards of Puerto Rico and the Virgin Islands" published in the Bulletin of the Seismological Society of America, Vol. 75, No.1. (February 1985): pp. 251-262.

3.4 Volcanic Eruptions

Mount Liamuiga is a dormant volcano but does have the possibility to become active sometime in the future. Volcanic activity is observed with certain fumerol activity both at Brimestone Hill and in Nevis. The likelihood of impact in the near future from a volcanic eruption is thought to be very low.

3.5 Floods

Heavy rainfall in the central mountain range causes large amounts of runoff through ghauts, rivers and steams. The recent road construction and bridge improvement project has substantially reduced and mitigated against the impact of heavy rain and flooding principly at the Wingfield River in Old Road, Godwin Ghaut and the Cayon River at Cayon. Prior to the road improvement project, these three areas

were often impassable in heavy rain conditions not necessarily associated with hurricanes. The coastal plane that extends throughout the perimeter of St. Kitts is relatively well drained. Other than in excessive rainfall conditions, flooding is not a major hazard. Some flooding and the retention of rainfall does occur near the Airport, Ponds Pasture and the Industrial Site.

3.6 Landslides

Historically, there have been some problem with landslides, particularly along ghaut levels where some sub-standard housing has been built mainly by squatters without formal authority. This is potentially a high-risk area and steps should be taken to mitigate against continued construction of this kind. Areas in the village of Challengers were heavily impacted during Hurricane Luis and Marilyn in 1995. The Timothy Hill cut on the south east Pennisula Road is potentially a high-risk area in the event of excessive rainfall conditions.

3.7 Fire

The central core of Basseterre and the western extension of the core, i.e. the McKnight area, have many timber buildings and many buildings with masonry to the ground level and timber on the upper level. There is considerable risk of fire spreading as buildings are close together, older wooden buildings are extremely vulnerable to this hazard.

3.8 Miscellaneous

In 1854 an outbreak of cholera caused the death of 3,920 persons. The great fire of Basseterre in 1867 rendered 5,000 persons homeless. In 1880 there was what was known as the great flood of Basseterre where there were 36 inches of rainfall and 231 persons died. In 1970 the motor vessel Christina sank and 227 people lost their lives.

4.0 THE VULNERABILITY OF SCHOOL BUILDINGS

4.1 Methodology

Public Works, NEMA, and Consulting Engineering Partnership (CEP) of Barbados reviewed a select (see Table 2) list of schools and shelters to assess their vulnerability to natural hazards and also to assess their suitability for retrofitting for use as shelters in times of need following impact by natural hazards, primarily hurricanes.

The survey form in Annex 10.1 was developed by CEP in collaboration with the OAS. Results/feedback from the survey work undertaken in St. Kitts is awaited. This work will address both the degree of vulnerability to natural hazards and the capacity and suitability to retrofitting each of the target schools.

TABLE 2

List of 20 Shelters selected by the Government of St. Kitts and Nevis to be surveyed and evaluated by CEP

Number	Category	Name of Building	Location
1	Secondary	Community Centre	Trinity
2	Main	Community Centre	Parsons
3	Main	Community Centre	Keys
4	Main	Community Centre	Conaree
5	Main	Day Care Centre	C.A. Paul Southwell Industrial Park
6	Main	Community Centre	McKnight
7	Secondary	Community Centre	Freeman's Village
8	Secondary	Community Centre	Challengers
9	Main	Primary & Secondary Schools	Verchilds
10	Main	Newton Ground All Age School	Newton Ground
11	Main	St. Pauls Primary School	St. Pauls
12	Secondary	Tabernacle Primary School	Tabernacle
13	Main	Molyneux Primary School	Molyneux
14	Secondary	Cayon High School	Cayon
15	Secondary	Factory Social Centre	Kittstodart
16	Main	Basseterre High School	Victoria Road &Park Range
17	Main	Basseterre Junior High School	Taylors
18	Main	Fitzroy Bryant College	Burdon Street
19	Main	Newtown Primary School	Ponds Pasture
20	Main	St. Peters Primary School	St. Peters

4.2 Profile of schools

Design specification and general building quality vary considerably across the inventory of school buildings. Some schools are better suited than others for retrofitting. The survey and review process is designed to indicate those school buildings which, from a construction and engineering perspective, are most suitable for upgrading.

It should be noted that there are a number of common problem areas to schools that make upgrading both difficult and expensive. Essentially all school buildings have been designed as an envelope to protect occupants and users from the elements – the sun, wind, and rain.

In this region, schools are not necessarily designed to withstand earthquakes or hurricanes. They generally provide, as mentioned above, protection from the elements. Most roofs are either timber or metal framed with an outer membrane of galvanized sheeting or other form or moisture resistant material. Poured concrete roofs do not exist. Window openings are either of louvers or some form of jealousy fixture to facilitate ventilation. No schools have permanent storm shutters. Current designs and specifications render schools highly vulnerable to natural hazards particularly hurricanes and earthquakes.

Table 3 indicates the natural hazard vulnerability of public schools in St. Kitts. Annex 10.1 indicates the locations of all public schools on the island.

5.0 POLICES

5.1 Existing Policies that Pertain to School Buildings and Shelters

Historically school buildings, because they are in the public sector, have been designated as emergency shelters. Most school buildings are not designed or retrofitted to withstand the worst and most likely of natural hazards i.e. hurricanes and earthquakes. Indeed schools are amongst the buildings in the community most at risk due to their design and specification.

Schools were severely impacted in Hugo, Luis and Marilyn (see Table 4). The principal damage was caused by high winds and exacerbated by the ingress of large volumes of rainwater which further damaged, not only parts of the physical structure, but the contents as well as fixtures and effects. This vulnerability, to principally hurricane conditions, makes the school buildings in their present form not the most suitable of basic structures for emergency shelters.

Government has encouraged what is known as the "buddy system" in the past. Essentially this policy encourages neighbours, friends, and family to assist each other as follows:

1. Persons who believe their home is at risk from say a hurricane threat are encouraged to temporarily move in with friends or family who have housing of a standard perceived to be able to withstand high winds.
2. Post-event, i.e. after a hurricane, move in with friends or family as available.

Designated school buildings and other buildings within the community which are to be used as emergency shelters are opened on a post-event basis.

TABLE 3

School Vulnerability Matrix

School Name	Hurricane	Earthquake	Landslide	Volcano	Flood
1. Beach Allen	X	*			
2. Bronte Welsh	X	*			
3. Cayon	X	*			
4. Dr. William Connor	X	*			
5. Dieppe Bay	X	*			
6. Estridge	X	*			
7. Irishtown	X	*			
8. Molineaux	X	*			
9. Newton Ground	X	*			
10. Newtown	X	*			
11. Saddlers All Age	X	*			
12. Sandy Point	X	*			
13. St. Peters	X	*			
14. St. Pauls	X	*			
15. Tabernacle	X	*			
16. Verchilds	X	*			
17. Basseterre High	X	*			
18. Basseterre Junior	X	*			
19. Cayon High	X	*			
20. Sandy Point High	X	*			
21. Verchilds High	X	*			

* Potential for a large earthquake is unknown, however, the estimated maximum magnitude (Ms) is plus or minus 4

Source of the information pertaining to earthquake vulnerability: McCann, W.R. "On the Earthquake Hazards of Puerto Rico and the Virgin Islands" in the Bulletin of the Seismological Society of America, vol. 75, no. 1 (February 1985), pp. 251-262.

This is because it is not possible to establish pre-event those shelter buildings that will withstand and/or survive an event. This has serious impact on disaster planning and event impact reduction as none of the schools designated as shelters are considered to be strong enough to open as shelters prior to the impact of an event.

The different natural hazards that can impact and which give rise to the need for shelters dictate varying scenarios. A severe earthquake for example will impact differently than a hurricane, landslide or flood.

Hurricane impact is the principal natural hazard and the risk level from this hazard is by far the greatest. This factor should have a weighted impact on policy considerations. A hurricane is by far the most likely event to trigger school buildings into use as shelters and policy considerations should be biased to reflect this reality.

Accepting the premise contained above, a policy structure needs designing that will facilitate the retrofitting of schools as shelters based on hurricane conditions. Table 4 indicates the event, school, and nature of impact in Hurricane Hugo, Luis and Marilyn.

5.2 Existing Norms, Performance Standards and Building Codes

Present design criteria and specifications are adequate to fulfill the criterion of shelter in school construction. This means that the envelope that is designed and built will provide just that, shelter. The current building practise and normal procedure employed by designers and the building board are adequate to accomplish the objective of "shelter". However, policy implications need to be broader if both new school construction and retrofitting to existing structures is to be carried out to, in effect, hurricane proof school buildings.

Additionally, ancillary services in schools, i.e. bathrooms, septic systems, water, electricity and kitchen facilities, require attention and review in order to be appropriate if schools are being used as emergency shelters as opposed to schools. Occupant usage will change substantially in the event schools are in use as emergency shelters and these needs will require "factoring in" to a solution.

5.3 Maintenance

Maintenance is important in both the day to day operation of the schools and their availability and readiness for use as emergency shelters. Presently, Public Works responds in a reactive sense to requests for repair and upgrading work from the Ministry of Education. The Ministry of Education has indicated its desire to have its own maintenance division or department. The change in policy would make the maintenance issue into a maintenance programme and would facilitate a pro-active as opposed to reactive response. Preventative maintenance is not employed and no formal management of maintenance, either routine or preventative, is practiced at this time.

TABLE 4

Impact on Schools from Hurricanes Hugo, Luis and Marilyn

Event	School	Nature of Damage
Hugo	Trinity	Totally demolished, Bronte Welsh is the replacement school
	Basseterre Junior High	Serious roof damage
	Basseterre High	Roof and library damage
	Saddlers	Roof destroyed
	Sandy Point Primary	Roof damage
	Sandy Point High	Roof damaged
	Newtown Primary	Considerable overall damage, repairs sponsored by TDC (TDC is a private company in St. Kitts)
Luis and Marilyn	Basseterre Junior High	Major roof damage
	Cayon High	Minor roof damage
	Saddlers	Rood destroyed
	Irishtown	Minor damage to louvers
	Lodge (part of Molyneaux)	Roof damage
	Keys (with Cayon)	Roof damage
	Sandy Point High	Roof damage

6.0 PROCESS

There is no formal process that takes place in designing a new school or reconstruction following an impact from a natural hazard. In an anecdotal sense the process works like this:

After any event NEMA's damage assessment team initially undertakes an analysis of damage. The Ministry of Education then indicates its own assessment along with Public Works and the appropriate action is taken after discussions with the Planning Unit and the Ministry of Finance. (see table 5)

Depending on the severity of the impact to a building (a school) or to the inventory as a whole, repair work is prioritized and implemented as funds permit. It should been noted that all schools are at full capacity in terms of the number of students accommodated and that any reduction in capacity is a major problem requiring busing and double shifting.

Minor impacts are readily addressable both in terms of physical and financial capacity, but larger more comprehensive damage to the inventory is problematic. Retrofitting to higher, more impact resistant standards post-event is difficult. The pressure is great to bring impacted school buildings back into service

as quickly as possible. The re-design of roofs when there is not total damage presents many challenges as sometimes repairs are all that are effected.

By way of example, if a school building roof is say fifty percent damaged by a windstorm (not a full hurricane) it is not practical, under present constraints, to remove the undamaged portion and replace the entire roof. Repair is what takes place. The repaired roof, however, is still vulnerable to future impact by windstorm and hurricane.

7.0 PROJECTS

7.1 Mitigation and Retrofitting – What is it? – Why do it?

Mitigation is the result of taking measures and implementing steps to reduce the impact of, in this context, natural hazards. The outcome is improved building survivability. Retrofitting is the upgrading and improvement of buildings and their structural components, i.e. walls, doors, windows, roofs and associated systems (mechanical, electrical, plumbing, sewerage, water etc.).

The principal needs of school buildings for retrofitting is best described in lay, none technical terms, as confirming the integrity of structures that is hurricane-proofing roofs, windows, and door openings and providing temporary services post-event i.e. electricity (stand by generator) and water (storage tanks) and other necessary ancillary facilities such as septic systems.

Without a minimum of the general works mentioned above, none of the conventional schools is considered to be sufficiently reliable to be designated as an emergency shelter and to be opened on a pre-event basis. If it is a policy decision that a minimum number of schools located in strategic areas must be available as pre-event emergency shelters, then retrofitting and upgrading of selected schools is mandatory to fulfill the policy objective.

7.2 Design and Construction Criteria

As all school buildings do not have similar designs and specification nor is their current condition equal, each school building will have to be addressed on a custom basis as part of the prioritizing exercise.

7.3 Site (school) Selection and Community Involvement

School buildings need to be selected for retrofitting not only on the basis of their physical suitability or cost benefit analysis, but on their importance and relationship to their immediate community.

Population density and the vulnerability of the housing stock in a given area need to be considered urgently when prioritizing schools for upgrading. The community, through the local disaster preparedness committee, along with the Ministry of Education, the Planning Unit, Public Works, and the Ministry of Finance should form the core group in the decision making process.

7.4 Financing

Depending on the overall size of the school retrofit programme, external financing sources will almost certainly be required. It is not possible at this stage to address this issue until the dimension and scope as well as a time frame are known.

8.0 PREPAREDNESS

8.1 Existing Plans and Strategies

Currently, NEMA has an inventory of some 60 buildings designated as shelters of which, 20 are school buildings.

The present national plan and NEMA's response plan call for shelters to be opened on a post-event basis. It is not possible, with any degree of reliability, to forecast the extent to which the shelter inventory (school and non-school) would survive a hurricane's impact.

A percentage of the population who live in either sub-standard or marginal housing are at risk in the event of impact by a natural hazard (fire) in the older parts of Basseterre as well as the potential impact to the same target group by hurricanes.

8.2 Role of Teachers and Students

Teachers are an important resource with respect to the operation of a school. However, in times of schools being used as shelters, teachers may live away from schools and it may not be appropriate for them to be fully involved in shelter operation. Teachers and students should focus on disaster drills, mitigation procedures and preparedness as part of the school curriculum.

8.3 Links to Curriculum Development

Disaster mitigation and preparedness should be an integral part of the school curriculum and a programme similar to that adopted by the Partners of the Americas should be put in place in the Federation.

9.0 CONCLUSIONS

9.1 Findings

1. That currently school buildings are not adequate to serve as shelters and indeed have generally a very low level of survivability to natural hazards especially windstorm, hurricanes and earthquakes.
2. That it is desirable and necessary to have an inventory of emergency shelters to serve the population in times of impact from natural hazards especially windstorm, hurricanes and earthquakes.
3. That a formal process needs to be designed and implemented to facilitate, on an urgent basis, the retrofitting requirements of school buildings and the design, specification, construction and monitoring of the works.
4. That there is a need to improve disaster awareness in schools by teachers and students and that the school curriculum requires appropriate amendment and modification.
5. That there is very high level of teaching capacity vulnerability due to the low levels of natural hazard resistance in school buildings and that there is no excess capacity in the system.
6. That there is a need to educate the public and private sectors with respect to the vulnerability of the school building inventory to the impact of natural hazards.
7. That there is a need for standard operating procedures for disaster response in each school.
8. That there is need for a formalized feed back loop arrangement and co-operation between the Ministry of Education, the Planning Unit, the Ministry of Finance, Public Works, NEMA and the Contractor's Association.

9. That there is a need for greater input from school principals and technical staff in planning as it relates to potential disaster response at schools. These individuals should be part of a full consultative process.
10. That the process of workshop implementation should, to the extent possible, result in a pre-feasibility study package for eventual programme delivery.
11. That maintenance, routine and preventative, is a vital factor in the overall resistance and survivousility of school building.

9.2 Recommendations

That a task force should be formed to implement a retrofitting programme on prioritized school buildings to serve as emergency shelters. Such task force should be comprised of the following representatives:

- Ministry of Education 2
- NEMA 2
- Ministry of Finance 1
- Public Works 1
- Planning Unit 1
- Contractor's Association 1
- Engineer's Association 1

That the task force meet urgently to design a programme of work to implement the retrofitting objectives contained in this plan, focusing on the following core issues:

- Selection of buildings
- Relevance to the community i.e. need, population density, high-risk housing, and social issues
- Design, specification and modalities for improving buildings to windstorm and hurricane proofing standards
- Consider on its merits the requirement to windstorm, hurricane, and earthquake proof a minimum number of buildings
- Financing and cost benefit analysis and financial accounting
- Prepare the public sector equivalent of a private sector business plan with timeline and other appropriate resources to achieve the objectives

1. That the task force report to the Minister of Education.
2. That the Minister assist as required in seeking the necessary authorities from Cabinet.
3. That the task force request that NEMA design a public awareness support programme for the initiative.
4. That the school curriculum be amended and modified to include disaster preparedness both in the schools and the community and in teacher training.
5. That the Ministry of Education design and implement on an urgent basis evacuation and fire drills in all schools with an ongoing programme of upgrading and monitoring with fire evacuation drills practised on a regular basis.
6. That further consideration be given to the Ministry of Education forming its own maintenance division to practise routine and preventative maintenance and to establish a five-year maintenance plan and budget.
7. That NEMA undertake the necessary community training and support mechanism to facilitate the operation of nominated schools as emergency shelters.

10.0 ANNEXES

10.1 Map with the Location of Public Schools

(Oversized, not included)

10.2 Mandates Related to Vulnerability Reduction in the Education Sector

Permanent Council of the OAS, CP/ RES 546 (834/90). October 10, 1990

Resolution 3: To encourage member states to make natural hazard management and disaster relief integral components of their socio-economic development activities.

International Decade for Natural Disaster Reduction 1990-2000 (IDNDR) which was proclaimed by the General Assembly of the United Nations by Resolution 44-236.

Permanent Council of the OAS, CP/RES 593 (922/92). October 28, 1992

Resolution 4: To encourage member states to undertake natural hazards vulnerability reduction programs as an integral part of their efforts to alleviate conditions of poverty and underdevelopment and achieve sustainable economic growth.

Declaration of Cartagena, Interamerican Conference on Natural Disaster Reduction. March 21-24, 1994

Recommendation 2: In the understanding that such vulnerability is one of the shortcomings of underdevelopment and environmentally- harmful actions, it is essential to co-opt the political willingness to recognise that such vulnerability should be among the explicit objectives of sustainable development planning and an indicator of environmental impact accountability. The development of monitoring techniques and the tallying of disaster vulnerability factors must be seen as essential tools for disaster prevention and mitigation.

Recommendation 3: There is a need for eliciting greater community participation to gain greater in-depth understanding of individual and collective perceptions on such developments and their attendant risks and to assess the cultural and organisational features of the societies, aside form their behaviour and relationship with their physical and natural environment, which may hamper or enhance prevention and mitigation as well as those that encourage or hinder the protection of the environment for the development of future generations; these being fundamental aspects in the definition of effective and efficient resources to mitigate the impact of the disasters on the region.

Recommendation 5: Given the importance and validity of cultural aspects during disasters, there should be the strengthening and encouragement for educational programs for the population and training programs for researchers, planners, experts and officials so as to provide them with adequate, diversified knowledge of the realities in the region in order to incorporate preventive aspects not in the culture.

CIECC (Inter-American Council for Education, Science and Culture), OAS/RES 1995

Declaration of Santa Cruz de la Sierra and Plan of Action for the Sustainable Development of the Americas. October 1996

Initiative 6: Promote the inclusion of disease outbreak response and disaster planning, preparedness, and mitigation in national development plans; seek to establish, as appropriate, regional emergency response teams and regularly test contingency plans; and promote the establishment of appropriate building construction codes that include regulatory and enforcement mechanisms through the sharing of technical information and expertise.

Initiative 45: Foster the inclusion of sustainable development in urban development plans, including mechanisms for evaluating the environmental impact.

Interamerican Program for Sustainable Development (PIDI) of the OAS. June 25, 1997

Resolution 4.1b iii: Promote the exchange of information for supporting established networks for the exchange of experiences and methods in the forecasting and mitigation of natural disasters, so that this topic can be incorporated into national development programs.

Resolution 4.1 c.Provide co-operation for:

i) Curriculum innovation and adaptation to incorporate the environment and the concept of sustainable development into regional programs of basic education and education work.

iii) The incorporation of the topic of natural hazards mitigation in national development plans, the encouragement of the adoption of appropriate building codes, and the preparation, strengthening of regional disaster relief plans.

iv) The co-ordination of activities and services of projects supporting the preparation of vulnerability profiles and the preparation of sectoral investment plans to reduce vulnerability to natural disasters.

10.3 Survey Forms

- **Seismic Hazard Assessment Form Part I**
- **Seismic Hazard Assessment Form Part II**
- **Wind Hazard Assessment Form**

Seismic Vulnerability Assessment

FIELD SURVEY GUIDE - PART 1

Name of Facility:

ID Number:

Member Information:

Member	Plan dimensions	Concrete block strength	Concrete strength	Reinforcement grade & %	Structural steel grade	Timber grade	Commen
Main foundations							
Columns							
Walls							
Beams							
Slabs							
Rafters							
Purlins							
Roofing							

Photographs:

- North elevation
- East elevation
- South elevation
- West elevation

Structural Systems (longitudinal)

- Load-bearing walls
- Braced frames
- Column and beam
- Mixed systems (describe)
- Soft storeys
- Short columns

Structural Systems (transverse)

- Load-bearing walls
- Braced frames
- Column and beam
- Mixed systems (describe)
- Soft storeys
- Short columns

School	ID number	Direction	Number of storeys	Total floor area	Column area at base (above grade)	RC wall area at base (steel columns)	Masonry wall length at base
		T ——— L					
		T ——— L					
		T ——— L					
		T ——— L					
		T ——— L					

Seismic Vulnerability Assessment

Field Survey Guide—Part 2

School

ID Number

Column dimensions													
		1T	1L	2T	2L	3T	3L	4T	4L	5T	5L	6T	6L
A	3rd storey												
	2nd storey												
	1st storey												
B	3rd storey												
	2nd storey												
	1st storey												
C	3rd storey												
	2nd storey												
	1st storey												
D	3rd storey												
	2nd storey												
	1st storey												
Wall dimensions - Longitudinal													
		1-2	1-2	2-3	2-3	3-4	3-4	4-5	4-5	5-6	5-6	6-7	6-7
		length	thickness	length	thickness	length	thickness	length	thickness	length	thickness	length	thick
A	3rd storey												
	2nd storey												
	1st storey												
B	3rd storey												

	2nd storey												
	1st storey												
C	3rd storey												
	2nd storey												
	1st storey												
D	3rd storey												
	2nd storey												
	1st storey												

Wall dimensions - Transverse

		1	1	2	2	3	3	4	4	5	5	6	6
		length	thickness	length	thickness	length	thickness	length	thickness	length	thickness	length	thick
A-B	3rd storey												
	2nd storey												
	1st storey												
B-C	3rd storey												
	2nd storey												
	1st storey												
C-D	3rd storey												
	2nd storey												
	1st storey												
D-E	3rd storey												
	2nd storey												
	1st storey												

Sketch

Line sketches should be provided at each floor level indicating:

- Columns
- Reinforced concrete (RC) walls and
- masonry walls.

Steel columns should be noted on the sketches and their overall dimensions stated in the table. In general, the walls should be shown only when they are continuous from floor to floor.

Hurricane Vulnerability Assessment

FIELD SURVEY GUIDE

Building Data

1. Name of Facility
2. Address
3. ID Number
4. Surveyor's Name
5. Survey Date
6. Year Constructed
7. Years of Major Additions or Changes
8. Was building formally engineered?
    - Yes
    - No
    - Do not know
9. Number of Storeys
10. Windstorm Loss History (Add separate sheet for additional details if necessary)
11. Surveyor's Comments (Add separate sheet for additional details if necessary)

Environment

1. Is there potential of debris from metal or wooden buildings, trees, loose material or roofing within 300 ft radius?
    - Yes
    - No
2. What is the type of surrounding terrain?
    - Coastal
    - Open field
    - Town
3. What is the type of topography?
    - Flat or gently undulating
    - Hillside or ridge
    - Promontory or cliff

Roof Envelope

1. Indicate the geometry of the roof:

    - Flat
    - Gable
    - Hip
    - Other (describe)

2. What is the primary roof support system (supported at the exterior walls)?

    - Reinforced concrete
    - Steel beam
    - Steel truss
    - Open-web steel joist
    - Tapered steel beam
    - Wood truss
    - Wood beam or rafter
    - Other (describe)

3. Is there a positive anchorage system (such as hurricane straps) connecting the roof system at the exterior walls?

    - Yes
    - No
    - Do not know

4. What materials are used for the roof deck?

    - Cast-in-place concrete slab
    - Precast concrete
    - Metal deck
    - Wood battens
    - Plywood
    - Wood close boarding
    - Other (describe)

5. What type of roof covering is used?

    - Built-up roof with gravel
    - Standing seam metal roof
    - Metal profiled sheets
    - Asbestos cement sheets
    - Single-ply membrane
    - Tile roof
    - Timber shingles
    - Asphalt shingles
    - Other (describe)

6. What is the age of the roof covering?

    - Less than 5 years
    - 5 to 10 years

- 11 to 15 years
- 16 to 20 years
- greater than 20 years
- Do not know

7. Are there skylights or ventilators on the roof?

- Yes
- No

Wall Envelope

1. What is the primary vertical load resisting system at the exterior walls?

- Reinforced concrete
- Steel
- Reinforced masonry
- Unreinforced masonry
- Wood
- Other (describe)

2. What is the percentage of wall area covered by glass or mesh or open blocks?

- 0% to 5%
- 6% to 20%
- 21% to 60%
- Greater than 60%

4. Are the glass or mesh or open blocks provided with permanently installed shutters?

- Yes
- No

4. Indicate the type of cladding (other than in 2 and 3 above) used

- Reinforced concrete block masonry
- Unreinforced concrete block masonry
- Precast concrete elements
- Stone panels
- Metal panels
- Wood
- Other (describe)

6. Indicate the type of external doors in the building

- Metal panels
- Solid wood (incl T&G)
- Hollow-core plywood
- Solid-core plywood
- Other (describe)

Other Considerations

1. Are there awnings, canopies, covered walkways or carports?

    - Yes
    - No

2. What wind code was used for the design of the building?

    - BNS CP28 - Code of Practice for Wind Loads for Structural Design
    - CUBiC Part 2 Section 2 - Structural Design Requirements, Wind Loads
    - BS 6399 Part 2 - Code of Practice for Wind Loads. Year?
    - ASCE 7 - Minimum Design Loads for Buildings and Other Structures. Year?
    - South Florida Building Code. Year?

3. What damage was suffered by the buildings due to Hurricanes Luis and Marilyn in 1995? (Add separate sheet for additional details if necessary)

4. What types of repairs or types of reconstruction have taken place? (Add separate sheet for additional details if necessary)

5. What standards (with reference to wind and earthquakes) were used in the repairs or reconstruction? (Add separate sheet for additional details if necessary)

6. Surveyor's comments (Add separate sheet for additional details if necessary)

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